ACTSC371 — Introduction to Investments

Class notes for Fall 2019

by

Johnson Ng

BMath (Hons), Pure Mathematics major, Actuarial Science Minor

University of Waterloo

Table of Contents

List of Definitions

List of Theorems

List of Procedures

Preface

The main text used by this note is the optional textbook recommended by the course instructor, titled Investments. [1] This note also pulls information from lectures. This note shall also follow the general structure of the textbook, instead of my usual approach that is a per-lecture basis.

[1] Bodie, Z., Kane, A., Marcus, A. J., Perrakis, S., Ryan, P. J., and Switzer, L. N. (2015). *Investments*. McGraw-Hill Ryerson, 8th canadian edition

Thus far, I find that this textbook does give a pretty long lecture for its introduction. Perhaps it tried its best in actually covering as much ground but not going to deep, so that the reader can have a feel of the contents that are to come. However, it also feels like the authors are rather... distracted in their writing. It is rather difficult to keep track of what the authors are trying to convey. For instance, paragraphs that are meant to introduce reasons for a concept ends up giving an example about how the concept comes into play.

1 Introduction and Overview

The Environment of Investing

- **Capital investment** needs funds, which gives rise to capital markets.
- **Capital markets** exist for a plethora of financial instruments that meets the needs of investors and users of capital.
- Each of the above instruments, starting with stocks and bonds, are created and evolved to respond to the needs of these users.

1.1 A Short History of Investing

The financial market has gone through some turbulent times, and increasingly frequent as of recent. Many of the notable crashes in recent history have been fueled by irrationality, in that the public has failed to value a commodity for its intrinsic or 'actual' value.

On a related note, according to the course instructor, when a crash happens in the East, where new days come earlier, 'just like dominoes', the crash will sweep its way to the West. In such cases, monetary institutions can brace for impact.

The Crash of 1929 and the Great Depression Fortunes were rapidly made by supposedly brilliant investors, and this did not escape the attention of the media. The public went into a mania for investing, which ended up a phenomenal rise in the stock market averages, which then led to the **Crash of 1929**. This paved way to the **Great Depression**.

The One-day Panic in 1987 The **One-day Panic in 1987**, aka **Black Monday**, [1] attracted global attention as well. However, unlike the Crash of 1929, no economic collapse followed. This is likely due to more informed decision-making by monetary officials, and a stronger economic situation. The financial environment also turned out to be neutral for the year 1987.

[1] Wikipedia contributors (2019). Black monday (1987) — Wikipedia, the free encyclopedia. https://en.wikipedia.org/w/index.php?title=Black_Monday_(1987)&oldid=913476478. [Online; accessed 5-September-2019]

This crash, in turn, set stage for the economic and financial boom of the 1990s.

Technology Bubble in the 1990s With high pubic interest in the stock market, and nightly news reports on levels of market indices on various mediums, the stock market really soared in the 1990s. The most prominent increase was confined to the technology stage. Technological companies like Dell Computer and Cisco Systems grew unbelievably fast. However, this growth attracted the attention of unsophisticated investors.

This growth of these companies, as measured by the **Nasdaq market index**, was described as a "**bubble**", a term used to describe the unwarranted inflation in asset values. When the bubble finally 'burst', naïve investors lose money in the collapse as they enter the bubbling market long after the initial gain, and even experienced investors insisted on staying due to not wanting to lose out on gains. This eventually lead to the new millennium '**bear market**'.

The New Millennium 'Bear Market' The great 'bull market' [2] in the 1990s became a 'bear market' [3] for the new millennium. However, the decline ended in October 2002, at a level of more than 50% below the all-time high in 1999.

[2] A market that is optimistic.

[3] A market that is pessimistic.

Our 'Trustworthy' Banks A new bubble came along in the first decade of the new millennium, this time in real assets over financial ones, particularly in commodities such as copper, oil and many food staples, and especially in **real estate**. In the West, due to miscalculations of the **Federal Reserve** about a risk of deflation, interest rates were pegged at high values and mortgages soared. As a result, mortgage officers and banks complied with individuals with poor credit risks,

allowing these individuals to finance homes that are supposed to be unaffordable to them.

The mortgages that were issued were then resold by banks through **mortgage-backed securities**, and these banks also devised instruments with credit-backed obligations and circulated them. Investors of various scales traded these securities without understanding the risk that entails, much of it due to poor credit risks in the market. By the end of 2007, the cracks appeared, and it was revealed that many of the world's largest banks, who were deeply entangled in these instruments, were effectively bankrupt. The main concentration of these holdings was in the United States, the British, and the European banks; the Canadian banks, who also participated in the action earlier on, have largely divested themselves of the credit instruments by the collapse.

1.2 *The Economy and Investment*

When investors trade stocks, it is usually traded with another investor, who has the opposite idea of what the value of the company is — buyers think that the value of the stock is higher than the share price, while the sellers think that the value of the stock is lower.

The price in the market is important in establishing a fair valuation of the shares. This is relevant to the corporation when it issues new shares, when it requires new capital. The company itself is usually uninvolved in the trading; the company is usually only interested in knowing what the trade price says about the sentiment of investors about its financial prospects.

Shares in companies are used for companies to raise funds, so that they can expand and purchase physical assets. Investors have extra capital that companies need, and generally so because individuals have more funds than required for immediate needs.

To obtain capital, those with a deficit issue **securities**, which are bought by those with excess funds. We shall see a more formal introduction to securities later on, but we shall talk about stocks and bonds here, which are issued by private corporations.

Bonds are notes that acknowledge indebtedness and specify the terms of repayment; **stocks** are instruments that convey ownership rights to their holders, which no guarantee of any fixed, or even positive, return.

Stocks allow investors to participate in business activities while away from the drawbacks of individual ownership and partnership. They are relatively liquid, i.e. investors can fairly quickly extract the true value of the shares. Shares also offer limited liability, so that the greatest loss possible is the investment itself, in the case where the business goes out.

1.2.1 *Real Investment VS Financial Investment*

Definition 1 (Financial Investment)

The investment of individuals in stocks and bonds of corporations is known as ***financial investment****.*

Definition 2 (Real Investment)

A ***real investment****is when a corporation takes capital and invests it in productive assets.*

Remark 1.2.1

1. *Financial investment occurs as investors enter the securities markets and exchange cash for financial instruments. In this case, since only cash is exchanged between investors, no new capital reaches the corporations, and so no real investment occurs.*
2. *Real investments can be reinvestment profits, but major real investment requires issues of new debt or equity instruments.*

Definition 3 (Real Assets)

Real assets *determine the productive capacity of the economy.*

Remark 1.2.2

Real investments are channeled into real assets.

Example 1.2.1

Real assets can be:

- land;
- buildings;
- machines;
- knowledge necessary to produce goods; and
- workers.

Definition 4 (Financial Assets)

Financial assets *are related to financial investments, such as stocks and bonds.*

Remark 1.2.3

1. *Financial assets do not represent a society's wealth.*
   - *Shares of stock represent only ownership rights to assets, not the productive capacity of the economy.*
2. *Financial assets contribute to the productive capacity of the economy* ***indirectly****; it allows for separation of the ownership and management of the firm and facilitate the transfer of funds to enterprises.*
   - *When real assets used by a firm generate income, the income is allocated to investors by their ownership of the financial assets, usually by the percentage that they hold.*
   - *Bondholders, for instance, get a flow of income based on the* ***interest rate*** *and* ***par value*** *of the bond.*

- *Equityholders and stockholders get any residual income after bondholders and other creditors are paid.*

3. *Financial assets contribute to the wealth of individuals or firms that holds them, since they are claims on the income generated by the real assets or on the income of the corporation that issues the instruments.*

4. *Real assets are income-generating assets; financial assets are the allocation of income or wealth among investors. In a sense, financial assets can be viewed as a means by which individuals hold their claims on real assets.*

1.2.2 *Role of Financial Assets and Markets*

Financial assets and the markets where they are traded play several roles that ensure the 'efficient' allocation of capital to real assets in the economy.

Informational Role Stock prices reflect a **collective assessment** of the investors of the current performance and future prospects of a firm.

- When the market is more optimistic about the firm, share prices of the firm will rise.
- Higher prices eases the raising of capital for the firm, which then further encourages investment.

In this manner, stock prices serve to allocate capital in market economies, directing capital to firms (and other applications) with the 'greatest **perceived**' potential. However, this is not the absolute most 'efficient' way of allocating capital. Time and again, we have seen how this allocation goes to places where they are not in the best interest of the market, or simply ended up in failure and loss of money (e.g. the dot-com bubble).

This, however, is not to say that this model of our financial market is chosen arbitrarily. In fact, alternatives such as having a central planner or letting politicians make these decisions certainly have the same pitfalls. The willfulness of the market is cannot and will not be determined by a small group of people, in some sense.

Consumption Timing One does not have to immediately, or any time in the near future, consume their earnings in the presence of financial assets. We can, in a sense, 'store' our wealth in financial assets, so that we may then 'consume' them at a later time.

An example use-case is to save for retirement, where we are old and unable to generate income as we did when we are younger. During our youth, where we can make high-earnings, we can invest your savings in financial assets. Once we are old, we can then sell these assets to provide funds for consumption needs, or continue trading for bonds for a more reliable stream of income.

In other words, financial markets allow us to **separate decisions concerning current consumption from constraits that otherwise would be imposed by current earnings**.

Allocation of Risk Often, the most important decision to be made when creating an **investment portfolio** is the choosing of a **risky asset**. Higher risks usually gives higher return in investments, and so the above decision is not uncommon. To soften the risk, we typically **diversify** our investment by buying some other assets, typically those that are less risky. This process of investing in a risky investment while making sure that one does not crash too hard in the event of a failed investment is called an allocation of risk, and financial assets allow this practice.

Separation of Ownership and Management We see that many large corporations are not owner-operated. Often, corporate executives are selected by boards of directors, who oversee the management of the firm with respect to the interest of the actual owners — the shareholders. [4] This guarantees a level of stability to the firm; for instance, if the stockholders decide that they no longer wish to hold ownership of the firm, selling their ownership away has no impact on the management of the firm.

[4] Certainly, some of the shareholders can also be executives or directors themselves.

Definition 5 (The Agency Problem)

The possible substitution of personal interest for those of the owners is

known as ***the agency problem****.*

In our setting, the managers themselves are the agents that are supposed to act in the interest of the shareholders. However, there is a risk, perhaps a moral one, that the manager may not act as they are supposed to.

Several mechanisms have appeared to quell this problem:

1. Tying the income of managers to the success of the firm through compensation plans.
    - This typically comes in the form of stock options.
2. Boards of directors force out under-performing management teams.
3. Outsiders such as security analysts or mutual funds and pension funds monitor the firm, putting pressure on the management.
4. Bad performers are subject to the threat of a takeover.
    - (**Internal takeover**) Unsatisfied shareholders can launch a **proxy contest** to take control of the firm. [5]
    - (**External takeover**) An under-performing firm is at risk of being acquired by another firm that may wish to take out its competitors, or diversify their business by replacing management with their own.

Overuse of options causes its own agency problem. It creates a moral hazard for managers to engage in risky projects, or manipulate information to inflate stock prices, only to cash out and leave the company before prices return to normal levels.

[5] However, this threat is usually minimal. Statistically, most proxy fights have failed.

1.3 *Participants in the Financial Market: Individuals and Financial Intermediaries*

There are essentially 3 types of participants in financial markets:

1. **Households**: typically the net suppliers of capital, as savers.
    - Purchase securities issued by firms that need to raise funds.
2. **Firms**: typically net demanders of capital.
    - Raise capital now to pay for investment in real assets.
    - Income generated by real assets provides returns to investors who purchased securities issued by the firm.

3. **Governments**: can be either; depends on relationship between tax revenue and government expenditures.

1.3.1 Individuals and Financial Objectives

The objective of investing is to make a return on capital. There are various possibilities to the kind of return expected. The amount of return, the risk exposure, and the duration to a return can vary based on the preferences of the investor, which may vary depending on the stage of the investor's life.

Some investors are content with a **fixed return** if the principal is guaranteed; others look for opportunities to **double their investment** in days. These extremes are not in the interest of this course.

First significant decision for most individuals — Education The major asset that most people have during their earlier working years is their power to earn by drawing on their human capital. The risk of a crippling illness or injury is worse than the risk associated with their financial wealth. The most direct way of **hedging** this is by buying insurance.

First major economic asset for most individuals — Personal Residence This requires an evaluation of potential **appreciation** in residential values in the light of rental expenses. When considering real estate investment as an option for diversification, it may be the case that a personal portfolio is overweighted in real estate.

One of the risks associated with this investment is that if the asset is also meant as a personal residence, especially for someone who just owned their first house, the risk of a downturn in their employer's industry, or other related factors, may force the investor to give up on their house (in the event of a need to move).

Warning

*It is easy to get confused between **saving** and **safe investment**. The textbook gives the following example to clarify their differences:*

> *Suppose you earn* $100,000 *a year from your job and spend* $80,000 *on consumption. You save* $20,000*. Suppose you decide to invest all* $20,000 *in risky assets. Then you are still saving* $20,000 *but you are not investing it safely.*

1.3.2 The Investment Process

Definition 6 (Portfolio)

*A **portfolio** is a collection of investment assets.*

Remark 1.3.1

1. *A portfolio is updated or "rebalanced" by selling existing securities, using the proceeds to then purchase new securities.*
2. *The size of a portfolio can be increased by investing additional funds, and can be decreased by selling securities.* 💬

Investment assets can be categorized into broad asset classes, e.g. stocks bonds, real estate, commodities, etc.

Investors make 2 types of decisions when constructing their portfolios:

1. (**Asset allocation**) the decision to choose among the asset classes;
2. (**Security selection**) the decision to choose which particular securities to hold.

The following are 2 approaches to constructing a portfolio:

1. **Top-down portfolio**
   - Begins with asset allocation.
   - After deciding on assets, the investor turns to security selection.
2. **Bottom-up portfolio**
   - The portfolio is constructed first from buying securities that seem attractively priced without much concern for the resultant asset allocation.
   - This approach tends result in unintended bets in one or another sector of the economy.

A technique that is used for selecting securities is called **security analysis**, which involves valuation of particular securities that are being considered for a portfolio.

1.3.3 *Financial Intermediaries*

Financial intermediaries are institutions that stand between the security issuers (typically firms), and the ultimate owner of the security

(typically investors). The problem space that they are in has the following problems:

1. Corporations and governments do not directly trade their securities with individuals. Consequently, they do not market their securities to the public.
2. The small (financial) size of households makes it difficult to do direct investment.
   - It is unreasonable to do their own advertisement to look for prospective borrowers.
   - It is difficult for an individual investor to diversify across borrowers to reduce risk.
   - Dedicated time and effort needs to be put into assessing and monitoring the credit risk of borrowers and the market.

The common theme for both sides of the party is that it is not beneficial for these parties to fully dedicate their times into playing in this market, more so if their fields are not directly involved in the financial market.

Example 1.3.1 (Banks as a financial intermediary)

A bank raises funds by "borrowing" [6] and lending that money to other borrowers. Banks give its creditors a certain interest rate and charge its debtors an interest rate that is higher. The difference, called the **spread**, is the source of the bank's profit.

[6] Banks take deposits from its customers.

Through the bank, the lenders and borrowers need not contact each other, nor do they need to know each other. The bank acts as an intermediary between the two. The problem of matching lenders and borrowers is a non-issue when each party approach the bank independently.

Other examples of financial intermediaries are **investment companies**, **insurance companies**, and **credit unions**. They all offer similar services but in differing 'flavours'. Their similarities lie in:

1. the pooling of resources, so that they can lend considerable amounts to borrowers;

2. achieve significant diversification through the pooling process, allowing them to take on risks that are unreasonable on an individual level; and

3. build expertise through day-to-day business, and use economies of scale [7] and scope [8] to develop tools to assess and monitor risks.

[7] Cost advantages that a firms can obtain due to their scale of operation.
[8] Efficiencies formed by variety, not volume.

Example 1.3.2 (Investment companies as a financial intermediary)

The 'flavour' of problems that investment companies focus on are the following:

- household portfolios are not large enough to be spread among a wide variety of securities; and
- brokerage fees and research costs are expensive (also time-wise) to purchase a few shares of many different firms.

Investment companies can also design portfolios for larger investors with particular goals.

Example 1.3.3 (Mutual funds as a tool for a financial intermediary)

Mutual funds have the advantage of large-scale trading and portfolio management. Participating investors are given a **prorated share** of the total funds, with respect to the size of their investment. This solves many of the small investors' problem, with a management fee that they are willing to pay to the mutual fund operator.

Mutual funds are sold in the **retail market**, and the strategy of these funds are designed to attract large number of clients.

Example 1.3.4 (Investment bankers)

Investment bankers are born to fill the niche for firms that perform specialized services for businesses. They serve to offer their expertise in finance to firms that would prefer such a service over maintaining an in-house security issuance division. In Canada, they are also known as **investment dealers**. Some examples in Canada are Scotia Capital, RBC Investments, and BMO Nesbitt.

These bankers provide advice for corporations on the pricing of their securities, interest rates, etc. Essentially, the bankers handles the

marketing of the security in the **primary market**. [9]

Aside from their expertise, investment bankers offers their own reputation for honestly on the deal. When investors seek to buy securities, the branding of the investment banker serves as sort of a credibility check, just as one do when buying products as a regular consumer.

[9] The primary market is where new issues of securities are offered to the public. The stage where investors trade issued securities among themselves is called the **secondary market**.

1.4 *Recent Trends*

I shall come back to this later on.

There are 4 important trends in the modern investment environment:

1. globalization;
2. financial engineering;
3. securitization; and
4. information and computer networks.

2 Financial Markets and Instruments

The following a several major classes of financial assets or securities, of which we shall go into more detail, but will provided a brief description so that we may proceed:

1. Debt instruments
    - money market instruments
    - bonds — an instrument where the bondholder is the creditor, and the payment is usually in terms of interest and a final maturity payment
2. Common stock
    - the most common form of stocks, hence the name
    - common stockholders have voting and ownership rights of the company
    - common stockholders can get paid a dividend
3. Preferred stock
    - a special class of stocks, given preference due to order of paying back liabilities of the company (see below)
    - has ownership rights but typically no voting rights
    - preferred stockholders can get paid a dividend, typically before common stockholders
4. Derivative securities
    - instruments that are based on, or derived, from issued securities

- this is typically traded outside of the firm that issued the security of which the derivative is based on

The order of how companies pay their liabilities is:

creditors → preferred stockholders → common stockholders

2.1 The Money Market

- A sub-sector of the fixed income market.
- Consists of instruments, called **money market instruments** or **debt securities**, that are
  - **very-short-term**;
  - **highly marketable**;
  - **liquid**; and
  - **low-risk**.
- Money market instruments are also sometimes called **cash equivalents** due to their safety and liquidity.
- Money market investors **aim** to generate safe, short-term returns.
- Most of these securities trade in large denominations, making them out of reach for small investors.
- **Money market funds**, on the other hand, is accessible to small investors.

2.1.0.1 Money Market Instruments

Treasury Bills (T-bills)

- Most marketable of all Canadian money market instruments.
- Issued by the government to raise money.
- Usually issued at a bi-weekly **auction** for maturities of 1. 1 month; 2. 2 months; 3. 3 months; 4. 6 months; and 5. 1 year.
  - Chartered banks and authorized dealers can submit only **competitive bids**.

  - **Competitive bid** — order for a given quantity of bills at a specific offer price.
  - **Non-competitive bid** — unconditional offer to purchase at the average price of the successful competitive bid; submittable only for bonds.
  - Government rank-orders bids by offering price, and accepts bids in descending order [1] until the entire issue is absorbed.

[1] It is sensible to accept bids of the highest price, since that means that the government needs to pay back less.

- Also traded in the secondary market.
- Highly liquid.
- **Credit risk** is considered to be close to nil; governments can raise taxes to repay debt.
- Sold at a discount.
- Price is quoted based on Bond Equivalent Yield (BEY).

Certificates of Deposit (CD)

Definition 7 (Time Deposit)

*A **time deposit** is an interest-bearing deposit account with a specific date of maturity, and cannot be withdrawn before maturity. The deposit bearer will pay interest and the principal back to the investor only at maturity.*

Remark 2.1.1

1. *Time deposits are known as 'fixed deposits' in a certain country in the East.*
2. *While time deposits cannot be withdrawn by definition, some time deposits allow the investor to still withdraw their money but as a sign of cancellation, and either the full sum is paid back, or a small fee is charged.*

- CD is a time deposit with a chartered bank. [2]
- A similar time deposit for smaller amounts is known as a **guarantee investment certificate (GIC)**.

[2] A **chartered bank** is a bank that has received regulatory approval to operate. The specifics of what they can do as a chartered bank differs from country to country.

- Both CDs and GICs are non-transferable in Canada; but certain banks allow for transfer for those with great denominations.
- Transferable CDs in Canada are known as **bearer deposit notes** (BDNs).
- CDs in the US are marketable.

Commercial Paper

- Short-term unsecured debt notes.
- Typically issued by large, well-known companies.
- Often backed by a bank line of credit. [3]
- Range: $\leq$ 1 year; longer maturities require registration under the **Ontario Securities Act** and thus almost never used.
  - Most often issued with less than 1 or 2 months; with minimum denominations of $\$50,000$.
  - This means that small investors can only access commercial papers indirectly, via **money market mutual funds**.
- Almost all commercial papers are now rated for credit quality by rating agencies. [4]
- Considered a fairly safe asset due to short term.
  - If investors doubt the credit-worthiness of the firm, the firm may be forced to pick other methods of financing, which are most costly. (E.g. Olympia and York – March 1992)
- Financial firms like banks have also started issuing commercial papers, usually called **asset-backed commercial paper**.
  - These are short-term instruments used to raise funds, for the institution to invest in other assets.
  - These assets are collateral for the commercial paper — hence the namesake.
  - A notorious example of where the investment goes was into subprime mortgages, where we saw in summer of 2007.

[3] A **line of credit** is an arrangement between a financial institution and a customer, and it establishes the maximum amount that the customer can borrow. A bank line of credit is a line of credit where the financial institution is the bank.

[4] **Rating agencies** are agencies that rate a debtor's ability to pay back principals and interests in a timely manner, and their likelihood of defaulting.

Bankers' Acceptance

- Is an order to a bank, by a bank's client, to pay an amount to a holder at a future date.
  - Bank endorses the order for payment as "accepted", hence the name.
  - Bank assumes responsibility for eventual payment.
  - This makes Bankers' Acceptances second only to T-bills in terms of security.
- Typically issued for 6 months.
- Once issued, Bankers' Acceptances are tradable in the secondary market.
  - Traders may substitute the bank's credit standing for their own.
  - Sold at discount of the face value of the payment order; hence yield is calculated similarly.

Eurodollars

- US dollar-denominated deposits at foreign banks or foreign branches of US banks.
  - Not under regulation of the US Federal Reserve Board.
  - Despite the name, Eurodollars need not be based on European banks, but it is where Eurodollars began.
- Most Eurodollar deposits are large.
- Most Eurodollars are time deposits with less than 6 months' maturity.
- The **Eurodollar** certificate of deposit is a variation of the Eurodollar time deposit.
  - Tradable, which a typical time deposit is not.
  - Considered less liquid and riskier than US CDs; hence higher yields.
- **Eurodollar bonds** — dollar-denominated bonds in Europe.

  - **Not** a money market instrument due to long maturities.
- All above Eurodollar-related instruments also exist denominated in all major currencies.
  - They are called **Eurocurrency instruments**; e.g. they are called Euro-Canadian dollars in Canadian Dollars.
  - Constitute a minor portion of the Eurocurrency market, which is dominated by Eurodollars.

Repos and Reverse Repos

- Are short-term, typically overnight, borrowing.
- Frequently used by dealers in government securities.
- Sold to an **institutional investor** as collateral, with the promise to buyback the next day with an **overnight interest**.
- Considered very safe; backed by government securities.
- A **term repo** is a similar instrument, except that the duration of the agreement can be 30 days or more.
- A **reverse repo** is when the dealer finds an investor holding government securities and buys them, with the agreement to sell them back.

Federal Funds

- Aka **fed funds**.
- A minimum balance in a reserve account that a member bank in the US is required to have with the Federal Reserve.
- Banks with excess funds lend to those with a shortage at the so-called **federal funds rate**, usually as overnight transactions.
- Fed funds market was meant to help banks meet the minimum requirement, but many large banks consider the fund as a component of their total funding.
- The fed fund rate is recognized as a **key barometer** of monetary policy.

Brokers' Call Loans

- Individuals who buy stocks on margin [5] borrow part of the funds from their broker. The broker may borrow the funds from a bank, agreeing to pay back on call.
- Chartered banks make these call loans on investment firms to finance their inventory of securities.
- Interest rate on these loans is usually closely related to the rate of short-term T-bills.

[5] This means that the investor borrows some money to buy a stock.

The LIBOR Market

- Full name: London Interbank Offered Rate.
- Is the rate at which large banks in London are willing to lend each other money.
- Became the premier short-term interest rate quoted in the European money market.
- Used as a reference rate for many transactions. (e.g. LIBOR +2%)
- May be tied to currencies other than USD; e.g. British pound, yen, euros.
- **EURIBOR** (**European Interbank Offered Rate**) is a similar rate at which banks in the Eurozone are willing to lend euros among themselves.

2.1.0.2 *Yields on Money Market Instruments*

Definition 8 (Par Value / Face Value)

*Given a T-bill, the **par value** (or **face value**) of the T-bill is the value of the T-bill at maturity.*

Definition 9 (Bond Equivalent Yield (BEY))

*The **Bond Equivalent Yield (BEY)**, denoted as r_{BEY}, is a calculation for restating semi-annual, quarterly or monthly discount T-bill into an annual yield. In particular, there are 2 standards that are used in the market to calculate r_{BEY}. Let F be the par value, P be the selling price of the T-bill, and n the maturity of the T-bill in days of a year. In Canada, we use the **exact method**, which states that*

$$r_{\text{BEY}} = \frac{F-P}{P} \times \frac{365}{n}.$$

*In the US, the BEY is known as the **Bond Discount Rate** (BD), denoted by r_{BD}, where*

$$r_{\text{BD}} = \frac{F-P}{F} \times \frac{360}{n}.$$

Remark 2.1.2

1. *Perhaps the best way to think about the naming is to think of the name as being archaic; "bonds" were issued for 1 year in the old days. These calculations were devised to calculate the rate of a similar instrument with a shorter period, in a way so that they may be comparable to the one-year T-bill.*

2. *The BEY is **not** an accurate measure of the effective rate of return. This is because the BEY uses simple interest rather than compounded interest. The next example illustrates this.*

3. *The BEY is also known as a **annual percentage rate** (APR), since is uses simple interest procedure to **annualize**, instead of compound interest.* [6]

[6] In the case of compound interest, we call such a rate the **annual percentage yield**, also known, perhaps more commonly to us, as the **effective annual rate**.

Example 2.1.1 (BEY is not an accurate measure of the effective rate of return)

Consider a $\$1,000$ T-bill priced at $\$960$ now, maturing in 6 months. Then the effective rate of interest is

$$\left(1 + \frac{1000-960}{960}\right)^2 - 1 \approx 0.0851 = 8.51\%.$$

On the other hand, the BEY is

$$r_{\text{BEY}} = \frac{1000 - 960}{960} \cdot \frac{365}{182} \approx 8.356\%.$$

Proposition 1 (Relationship between BEY and BD)

Let F be the par value, P be the selling price of the T-bill, and n the maturity of the T-bill in days of a year. Then

$$r_{\text{BEY}} = \frac{365 \cdot r_{\text{BD}}}{360 - r_{\text{BD}} \cdot n}.$$

Proof

Note that

$$r_{\text{BEY}} = \frac{F - P}{P} \cdot \frac{365}{n}$$

and

$$r_{\text{BD}} = \frac{F - P}{F} \cdot \frac{360}{n}.$$

Equating the two by $\frac{F-P}{n}$, we get

$$\frac{r_{\text{BEY}} \cdot P}{365} = \frac{r_{\text{BD}} \cdot F}{360},$$

which thus

$$r_{\text{BEY}} = \frac{r_{\text{BD}} \cdot F \cdot 365}{360 \cdot P}.$$

Notice that by the formula of r_{BD}, we have

$$P = F\left(1 - r_{\text{BD}} \cdot \frac{n}{360}\right).$$

It follows that

$$r_{\text{BEY}} = \frac{r_{\text{BD}} \cdot \cancel{F} \cdot 365}{360 \cdot \cancel{F}\left(1 - r_{\text{BD}} \frac{n}{360}\right)} = \frac{365 \cdot r_{\text{BD}}}{360 - r_{\text{BD}} \cdot n}.$$

□

Proposition 2 (Relationship between the Effective Annual Rate and the BEY)

Let r_{eff} be the effective annual interest rate. Then

$$r_{\text{eff}} = \left(1 + \frac{r_{\text{BEY}}}{365/n}\right)^{\frac{365}{n}} - 1,$$

where n is the number of days to maturity of the T-bill at which r_{BEY} is based upon.

Proof

First, notice that if we let t be the period at which the bill is in place, and if we label the compound interest rate as i_c and the simple interest rate as i_s, then we can equate

$$(1 + i_c)^t = (1 + i_s t)$$

to find one interest rate from the other. It is important to note that since the period of both sides are the same, the period at which interest is applied are the same. In particular, since r_{BEY} is a type of annual simple interest, it follows that $i_c = r_{\text{eff}}$, and if we pick $t = \frac{n}{365}$, then

$$(1 + r_{\text{eff}})^{\frac{n}{365}} = (1 + \frac{r_{\text{BEY}}}{365/n})$$

and so

$$r_{\text{eff}} = \left(1 + \frac{r_{\text{BEY}}}{365/n}\right)^{\frac{365}{n}} - 1$$

as required. □

Remark 2.1.3

1. *By the definition of the Bond Equivalent Yield (BEY), we observe that*

$$\frac{r_{\text{BEY}}}{365/n} = \frac{F - P}{P},$$

where F is the face value of the T-bill and P its purchase price. Thus

$$(1 + r_{\text{eff}})^{\frac{n}{365}} = 1 + \frac{F - P}{P},$$

which also agrees with our notion of the effective annual rate.

2. *Since r_{BEY} is an annualized rate, we also call $\frac{r_{\text{BEY}}}{365/n}$ a 'deannualized' rate.*

2.2 The Bond Market

- Composed of borrowing instruments that have terms longer than those traded in the money market.
- These borrowing instruments are either called **debt instruments** or **bonds**.
  - Most of these instruments promise either
    - a fixed stream of income; or
    - a stream of income determined according to some formula.
  - Because of the above, they are also said to make up the **fixed-income capital market**.
    - In practice, the flow of income may not be fixed, thus the term "fixed income" is somewhat inappropriate.

Example 2.2.1

The following are some examples of:

- Publicly issued instruments: – Canada bonds – Provincial government bonds – Municipal bonds
- Privately issued instruments: – Corporate bonds – International Bonds – Mortgage-backed securities

Government of Canada Bonds

- The Canadian government issues non-marketable and marketable debt securities to borrow funds.
- Non-marketable debt securities
  - Both the following examples are
    - issued every year starting November 1
    - sale period may be a few months

    - has little interest rate risk
  - **Canada Savings Bonds** (CSBs) —
    - can be cashed any time prior to maturity at face value plus accrued interest
    - valuation is complex due to redemption feature
  - **Canada Permium Bonds** (CPBs) —
    - can only be cashed in November of succeeding years
    - interest rate rises if the realized holding period is longer
- Marketable debt securities
  - **Government of Canada Bonds** or **Canadas** or **Canada bonds** —
    - varying maturities at issue; range up to 40 years
    - considered part of the money market when their term becomes less than 3 years
    - generally noncallable
    - make semi-annual coupon payments
    - competitive coupon rates to ensure their issue at or near par value
    - there are listings that show the prices, periods and yields of these bonds
    - more detailed listings may also include
      - the change in yield and/or price from previous **close**
      - **bid** and **ask** prices, which respectively means the price at which an investor can sell or buy the asset on the market

Bibliography

Bodie, Z., Kane, A., Marcus, A. J., Perrakis, S., Ryan, P. J., and Switzer, L. N. (2015). *Investments*. McGraw-Hill Ryerson, 8th canadian edition.

Wikipedia contributors (2019). Black monday (1987) — Wikipedia, the free encyclopedia. https://en.wikipedia.org/w/index.php?title=Black_Monday_(1987)&oldid=913476478. [Online; accessed 5-September-2019].

Index